

# CLAIMS

1. A method of sealing a medical cartridge with a plastic closure, said medical cartridge including a tubular barrel portion having an open proximal end, a radial rim portion surrounding said open end, a reduced diameter neck portion adjacent said radial rim portion and a resilient stopper overlying said open proximal end and said rim portion of said medical cartridge, said method comprising:

forming a clear plastic closure of a polymer which is sufficiently malleable to permit radial deformation, yet sufficiently rigid to retain its shape following deformation, and sufficiently resistant to creep to maintain a seal between the container and the plastic closure following radial deformation, said plastic closure including a generally cylindrical tubular collar portion having an internal diameter generally equal to or slightly greater than an outside diameter of said rim portion of said medical cartridge and an integral radial rim portion;

telescopically disposing said generally cylindrical tubular collar portion of said plastic closure over said rim portion of said cartridge with said radial rim portion of said plastic closure overlying said rim portion of said cartridge and said generally cylindrical tubular collar portion surrounding said rim of said container having a free end surrounding said reduced diameter neck portion of said container; and

radially deforming said free end of said generally cylindrical tubular collar portion of said plastic closure incrementally into said reduced diameter neck portion of said cartridge beneath said rim portion, said free end of said plastic closure retaining its shape beneath said radial rim portion of said cartridge following deformation to permanently retain said plastic closure on said cartridge and sealing said cartridge proximal open end.

2. The method of sealing a medical cartridge with a plastic closure as defined in Claim 1, wherein said method includes compressing said integral radial rim portion of said plastic closure against said radial portion of said elastomeric stopper to seal said open proximal end and substantially simultaneously incrementally radially deforming and rolling  
 5 said free end of said closure tubular collar portion into said reduced diameter neck portion of said medical cartridge without discoloration of said clear plastic closure.

3. The method of sealing a medical cartridge with a plastic closure as defined in Claim 1, wherein said method includes incrementally rolling said free end of said generally  
 10 cylindrical tubular collar portion into said reduced diameter neck portion of said medical cartridge.

4. The method of sealing a container with a plastic closure as defined in Claim 3, wherein said method includes incrementally deforming and rolling said free end of said  
 15 tubular portion of said plastic closure into said reduced diameter neck portion of said medical cartridge using a crimping tool having an inclined surface, said method including relatively rotating said crimping tool and said medical cartridge with said plastic closure assembled thereon, simultaneously driving said inclined surface against said tubular portion of said closure adjacent said free end, simultaneously cold forming said free end incrementally into  
 20 said reduced diameter neck portion and against said rim portion of said medical cartridge, permanently deforming said free end into said reduced diameter neck portion and against said rim portion of said medical container.

5. The method of sealing a medical cartridge with a plastic closure as defined in Claim 4, wherein said inclined surface of said crimping tool is frustoconical and said method includes rotating said medical cartridge with said plastic closure assembled thereon and rotating said crimping tool.

6. The method of sealing a medical cartridge with a plastic closure as defined in Claim 4, wherein said method includes sequentially driving a plurality of crimping tools against said tubular portion of said plastic closure adjacent said free end, each of said crimping tools having an inclined surface of a decreasing angle of inclination, thereby incrementally deforming and rolling said free end of said plastic closure into said reduced diameter neck portion without damaging said plastic closure.

7. The method of sealing a medical cartridge with a plastic closure as defined in Claim 4, wherein said inclined surface of said crimping tool is stationary having a gradually decreasing angle of inclination and said method includes rotating said medical cartridge with said plastic closure assembled thereon and driving said medical cartridge with said plastic closure assembled thereon and rolling said medical cartridge and plastic closure against said gradually decreasing inclined surface.

8. The method of sealing a medical cartridge with a plastic closure as defined in Claim 7, wherein said gradually decreasing inclined surface is located on an inside surface of an arcuate rail and said method including simultaneously rotating said medical cartridge with said plastic closure assembled thereon against said inclined tapered surface of said rail, said tubular collar portion of said closure adjacent said free end being incrementally deformed against said inclined surface, and said tubular portion rolling along said arcuate inside inclined surface of said rail, gradually cold forming the circumference of said free end portion of said tubular collar portion into said reduced diameter neck portion of said medical cartridge.

9. The method of sealing a medical cartridge with a plastic closure as defined in Claim 1, wherein said method includes injection molding said plastic closure from a polymer alloy comprising a relatively malleable soft polymer and a relatively rigid polymer.

10. The method of sealing a medical cartridge with a plastic closure as defined in Claim 1, wherein said medical cartridge includes an open distal end, said method including fillings said barrel portion with a substance and sealing said open distal end by inserting an elastomeric stopper in said open distal end.

11. A method of sealing a medical cartridge with a polymeric closure, said medical cartridge including a tubular barrel having an open distal end and an open proximal end having a radial rim portion surrounding said open proximal end, a reduced diameter neck portion adjacent said radial rim portion, said method comprising:

molding a polymeric closure from a polymer which is sufficiently malleable to permit radial deformation, yet sufficiently rigid to retain its shape following deformation and sufficiently resistant to creep to maintain a seal between the polymeric closure and the medical cartridge following radial deformation, said closure including a generally cylindrical tubular collar portion having an internal diameter slightly greater than an outside diameter of said rim portion of said barrel and an integral radial rim portion and a central opening through said radial rim portion;

applying a pierceable stopper over said proximal end of said barrel;

telescopically receiving said tubular collar portion of said polymeric closure over said radial rim portion of said barrel with said radial rim portion of said polymeric closure overlying said pierceable stopper and said rim portion of said barrel and said tubular collar portion surrounding said rim portion and said reduced diameter neck portion of said barrel; and

incrementally cold forming and rolling said tubular collar portion of said polymeric closure with a crimping tool having an inclined surface facing said tubular collar portion opposite said neck portion of said barrel and relatively rotating said barrel and said crimping tool, said inclined surface of said crimping tool incrementally cold forming and rolling said tubular collar portion of said polymeric closure radially inwardly into said reduced diameter neck portion of said barrel, permanently securing said closure on said barrel and sealing said open proximal end.

12. The method of sealing a medical cartridge with a polymeric closure as defined in Claim 11, wherein said inclined surface of said tool is frustoconical and said method includes relatively rotating said crimping tool and said barrel and relatively driving said frustoconical surface against said tubular collar portion of said polymeric closure adjacent a  
5 free end of said tubular collar portion.

13. The method of sealing a medical cartridge with a polymeric closure as defined in Claim 12, wherein said method includes rotating said barrel with said polymeric closure assembled thereon relative to said crimping tool and driving said tubular collar portion of said  
10 polymeric closure against said inclined surface of said crimping tool.

14. The method of sealing a medical cartridge with a polymeric closure as defined in Claim 12, wherein said method includes sequentially driving a plurality of crimping tools against said tubular collar portion, said crimping tools each having an inclined surface of a  
15 decreasing angle of inclination, thereby incrementally rolling and gradually cold forming said tubular collar portion of said polymeric closure radially inwardly into said reduced diameter neck portion without damaging said polymeric closure.

15. The method of sealing a medical cartridge with a polymeric closure as defined  
20 in Claim 12, wherein said inclined surface of said crimping tool is located on an inside surface of an arcuate stationary rail and said method includes driving said tubular collar portion of said polymeric closure against said inclined surface and simultaneously rotating said barrel and said tubular collar portion rolling along said arcuate inside tapered surface of said crimping tool incrementally deforming the entire circumference of said tubular portion  
25 against said rim portion of said barrel.

16. The method of sealing a medical cartridge with a polymeric closure as defined in Claim 15, wherein said inclined surface of said crimping tool has a gradually decreasing angle of inclination, wherein said method includes driving said tubular collar portion of said polymeric closure against said inclined surface having a gradually decreasing angle of inclination, thereby rolling and gradually cold forming said tubular collar portion of said polymeric closure radially inwardly into said reduced diameter neck portion.

17. The method of sealing a medical cartridge with a plastic closure as defined in Claim 11, wherein said method includes compressing said integral radial rim portion of said polymeric closure against said pierceable stopper to seal said polymeric closure to said stopper and substantially simultaneously incrementally rolling and cold forming said tubular collar portion of said closure into said reduced diameter neck portion of said barrel.

18. The method of sealing a medical cartridge with a polymeric closure as defined in Claim 11, wherein said method includes filling said barrel with a substance and sealing said open distal end of said barrel by inserting an elastomeric stopper in said open distal end.

19. The method of sealing a medical cartridge with a polymeric closure as defined in Claim 11, wherein said method includes injection molding said polymeric closure from a polymer alloy comprising a relatively malleable soft polymer and a relatively rigid polymer.

20. The method of sealing a medical cartridge with a polymeric closure as defined in Claim 19, wherein said method includes co-injecting a polymer alloy including a polycarbonate and a soft malleable co-polymer.

21. A method of sealing a medical cartridge with a polymeric closure, said medical cartridge including a barrel having an open distal end and an open proximal end, including a radial rim portion surrounding said open proximal end and a reduced diameter neck portion adjacent said rim portion and an elastomeric septum received over said open proximal end of said barrel including a rim portion overlying said rim portion of said barrel, said method comprising the following steps:

forming a polymeric closure including a generally cylindrical tubular collar portion having an internal diameter generally equal to or slightly greater than an outside diameter of said rim portion of said barrel and an integral radial rim portion having a central opening from a polymer which is sufficiently malleable to permit radial deformation, yet sufficiently rigid and resistant to creep to retain its shape following deformation;

telescopically receiving said tubular collar portion of said polymeric closure over said radial rim portion of said barrel and said rim portion of said elastomeric septum with said rim portion of said polymeric closure overlying said rim portion of said elastomeric septum and said tubular collar portion surrounding said rim portion and said reduced diameter neck portion of said barrel; and

compressing said rim portion of said polymeric closure against said rim portion of said elastomeric septum, and incrementally rolling and gradually cold forming said tubular collar portion of said polymeric closure against an inclined surface of a crimping tool having a decreasing angle of inclination opposite said neck portion of said barrel and relatively rotating said barrel against said inclined surface of said crimping tool, thereby incrementally rolling and gradually cold forming said tubular collar portion of said polymeric closure radially inwardly into said reduced diameter neck portion of said barrel, permanently securing said closure on said barrel and sealing said open proximal end of said barrel.



22. The method of sealing a medical cartridge with a polymeric closure as defined in Claim 21, wherein said method includes sequentially driving a plurality of crimping tools against said tubular collar portion of said polymeric closure each having an inclined surface of a different decreasing angles of inclination, thereby rolling and gradually cold forming said tubular collar portion of said polymeric closure into said reduced diameter neck portion of said barrel.

23. The method of sealing a medical cartridge with a polymeric closure as defined in Claim 21, wherein said method includes rolling and gradually cold forming said tubular collar portion of said polymeric closure by driving said barrel and polymeric closure against a stationary crimping tool having a gradually decreasing angle of inclination and simultaneously rotating said barrel and polymeric closure while maintaining compression of said radial rim portion of said polymeric closure against said rim portion of said elastomeric septum.

24. The method of sealing a medical cartridge with a polymeric closure as defined in Claim 21, wherein said method further includes filling said barrel with a substance and sealing said open distal end by inserting an elastomeric stopper in said open distal end.